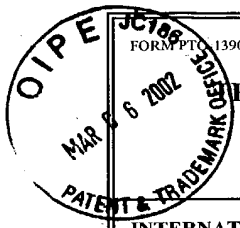


1010 Rec'd PCT/PTO 06 MAR 2002



FORM PTO 1390

U.S. Department of Commerce Patent and Trademark Office

Attorney's Docket No.

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371**

2185-151

U.S. Application No. (if known, see 37 CFR 1.5)

**10/070378**

INTERNATIONAL APPLICATION NO.

PCT/EP00/08562

INTERNATIONAL FILING DATE

01 September 2000

PRIORITY DATE CLAIMED

08 September 1999

**TITLE OF INVENTION: METHOD FOR PRODUCING A SANDWICH PANEL AND A BODY COMPONENT**


**APPLICANT(S) FOR DO/EO/US: Kurt BEHRE**

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
  - b. ☒ has been communicated by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
  - a. ☒ is attached hereto w/5 sheets of drawings.
  - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ have been communicated by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

**ITEMS 11. TO 20. below concern other document(s) or information included:**

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
14. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: Courtesy Copy of PCT Publication(w/drawings & Int'l Search Report); PCT/IPEA Form 416; PCT/IB Forms /301, 304, 306, 308 and PCT/RO Form 105.

U.S. APPLICATION NO. (if known) <b>107 070378</b> (37 CFR 1.52)		INTERNATIONAL APPLICATION NO. PCT/EP00/08562		ATTORNEY DOCKET NO. 2185-151					
21. <input checked="" type="checkbox"/> The following fees are submitted: <b>Basic National Fee (37 CFR 1.492)(a)(1)-(5):</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report Not Prepared by EPO or JPO. . . . . \$ 1,040.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report has been prepared by the EPO or JPO . . . . . \$ 890.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO . . . . . \$ 740.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but claims did not satisfy provisions of PCT Article 33(1)-(4) . . . . . \$ 710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) . . . . . \$ 100.00  <div style="text-align: right;">ENTER APPROPRIATE BASIC FEE AMOUNT =</div>				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%; text-align: left;">CALCULATIONS</th> <th style="width: 50%; text-align: left;">PTO USE ONLY</th> </tr> <tr> <td style="height: 150px; vertical-align: bottom;">\$890.00</td> <td></td> </tr> </table>		CALCULATIONS	PTO USE ONLY	\$890.00	
CALCULATIONS	PTO USE ONLY								
\$890.00									
Surcharge of \$130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">\$</td> <td style="width: 50%;"></td> </tr> </table>		\$			
\$									
Claims	Number Filed	Number Extra	Rate						
Total Claims	09 -20 =	0	X \$18.00	\$00.00					
Independent Claims	02 - 3 =	0	X \$84.00	\$00.00					
Multiple dependent claim(s) (if applicable)			+ \$280.00	\$00.00					
TOTAL OF ABOVE CALCULATIONS =				\$00.00					
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$					
SUBTOTAL =				\$890.00					
Processing fee of \$130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$					
TOTAL NATIONAL FEE =				\$890.00					
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$					
TOTAL FEES ENCLOSED =				\$890.00					
				Amount to be refunded	\$				
				charged	\$				
a. <input checked="" type="checkbox"/> A check in the amount of <u>890.00</u> to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. 02-2135 in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2135. A duplicate copy of this sheet is enclosed. <b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a)          or (b)) must be filed and granted to restore the application to pending status.</b>									
SEND ALL CORRESPONDENCE TO:  <b>Customer No. 6449</b>  George R. Repper Rothwell, Figg, Ernst & Manbeck 1425 K St., N.W., Suite 800 Washington, D.C. 20004 Phone: 202/783-6040			 _____ Signature  _____ Name  _____ 31,141 Registration Number						

<b>IN THE UNITED STATES PATENT AND TRADEMARK OFFICE</b>	<i>Application Number</i>	New Application
	<i>Filing Date</i>	Herewith
	<i>First Named Inventor</i>	Kurt BEHRE
	<i>Group Art Unit</i>	Unassigned
	<i>Examiner Name</i>	Unassigned
	<i>Attorney Docket Number</i>	2185-151
<i>Title of the Invention:</i> <b>METHOD FOR PRODUCING A SANDWICH PANEL AND A BODY COMPONENT</b>		

### PRELIMINARY AMENDMENT

Assistant Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

Please amend the above-identified U.S. patent application as follows prior to examination on the merits.

#### IN THE CLAIMS:

Please cancel claims 1-17 and substitute new claims 18-26 as follows:

18. (New) A method for producing a sandwich panel, comprising the following steps:

- forming a multiplicity of cup-like recesses in a flexible metal foil, and
- applying a covering layer to each side of the flexible metal foil, during which process, at each cup-like recess, first of all the opening is closed by one covering layer, and then the other covering layer is applied to the free ends of the recesses.

19. (New) The method as claimed in claim 18, characterized in that the cup-like recesses are formed by pressing or by deep-drawing.

20. (New) The method as claimed in claim 18, characterized in that the cup-like recesses are shaped substantially in the form of an ellipsoid or a sphere or a cylinder or a truncated cone or a truncated pyramid.

21. (New) The method as claimed in claim 18, characterized in that at least one of the covering layers is adhesively bonded to the flexible metal foil.

22. (New) A method for producing a body component, comprising the following steps:

- forming a multiplicity of cup-like recesses, which point in one direction, in a flexible metal foil,
- forming a laminated structure by applying a covering layer to that side of the flexible metal foil on which the openings of the cup-like recess are located,
- applying an adhesive to the end faces of the recesses,
- joining the laminated structure to a metal body sheet, the end faces of the laminated structure being adhesively bonded to the metal body sheet by means of the adhesive.

23. (New) The method as claimed in claim 22, characterized in that the laminated structure and the metal body sheet are joined by the application of pressure and the simultaneous supply of heat.

24. (New) The method as claimed in claim 22, characterized in that the adhesive is an encapsulated, heat-activatable adhesive system.

25. (New) The method as claimed in claim 22, characterized in that, before the joining operation, foam systems, which are activated during the joining, are introduced between the laminated structure and the metal body sheet.

26. (New) The method as claimed in claim 22, characterized in that the covering layer is an aluminum sheet.

IN THE ABSTRACT:

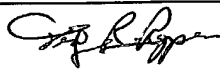
Please add the following Abstract of the Disclosure submitted on a separate sheet on the following page.

## ABSTRACT OF THE DISCLOSURE

The invention relates to methods for producing a light component (a sandwich panel or a component for a vehicle body) that is easy to construct. A plurality of cup-like cavities are embodied in a flexible metal foil. An outer layer is applied to each side of the flexible metal foil. The opening of each cup-like cavity is first covered by an outer layer and the remaining outer layer is then applied to the free ends of the cavities. An already formed sheet metal of the body can be connected to the tip surfaces of the cup-like cavities by an adhesive for producing a car body component, whereby said sheet metal is used as the remaining outer layer.

### REMARKS

This amendment is being made to substitute the claims as amended during PCT prosecution, and to provide an Abstract of the Disclosure on a separate sheet.

RESPECTFULLY SUBMITTED,					
NAME AND REG. NUMBER	George R. Repper, Reg. No. 31,414				
SIGNATURE				DATE	3-6-02
Address	Rothwell, Figg, Ernst & Manbeck Suite 800, 1425 K Street, N.W.				
City	Washington	State	D.C.	Zip Code	20005
Country	U.S.A.	Telephone	202-783-6040	Fax	202-783-6031

Method for producing a sandwich panel and for producing  
a body component

- 5 The invention relates to a method for producing a sandwich panel and for producing a body component.

The invention also relates to a sandwich panel and to a body component produced using a corresponding method.

10

Sandwich panels are known from the prior art, primarily as honeycomb sandwich panels, the honeycomb-like intermediate layer of which comprises a hard aluminum alloy. This layer is made "endless" in a discontinuous  
15 method by adhesive bonding by the individual structures. Finally, covering layers are laminated onto both sides of the honeycomb structure. The honeycomb sandwich panels formed in this way cannot be deformed in three dimensions, since the walls of the honeycomb  
20 cells are joined to one another. The procedure is discontinuous and therefore relatively uneconomical.

In another method for producing a sandwich panel which is known from the prior art, long PET tubes are stuck  
25 together to form a bundle. The PET tube bundle obtained in this way is then cut into disks perpendicular to the longitudinal extent of the PET tubes. Finally, covering layers are laminated onto both sides of each individual disk. This method too can only be carried out  
30 discontinuously.

The invention is based on the object of providing a method which allows sandwich panels and body components  
to be produced economically with little difficulty.

35



Furthermore, it is intended to provide a structurally simple and lightweight sandwich panel and body component.

5 This object is achieved by a method for producing a sandwich panel having the features of patent claim 1. Advantageous and preferred refinements of the method according to the invention form the subject matter of claims 2 to 4.

10

A sandwich panel according to the invention forms the subject matter of patent claim 5. Advantageous and preferred embodiments of the sandwich panel according to the invention form the subject matter of claims 6 to 10.

15

The particular advantage of the method according to the invention compared to the methods for production of a sandwich panel which are known from the prior art consists in the fact that the method can be carried out continuously, despite using an intermediate layer made from soft, flexible aluminum material.

20

A sandwich panel according to the invention has a high strength and is extremely lightweight. Moreover, it can be designed so that it can be deformed in three dimensions by using a suitable arrangement of the recesses.

25

30 Sandwich panels which have been produced in accordance with the invention can preferably be used in automotive engineering (roof linings, rear parcel shelves, etc) and in display technology.

30

35 The cup-like recesses can be formed by pressing or by deep-drawing.

35

To allow the cup-like recesses to be formed without damage to the material, the material of the flexible metal foil preferably has a modulus of elasticity of at least  $70 \times 10^3 \text{ N/mm}^2$ .

5

The flexible metal foil expediently consists of Al or an Al alloy or of Cu or a Cu alloy, which is expediently from  $10 \mu\text{m}$  to  $200 \mu\text{m}$ , preferably  $20 \mu\text{m}$  to  $100 \mu\text{m}$ , thick.

10

The cup-like recesses are formed substantially in the shape of an ellipsoid, a sphere, a cylinder, a truncated cone or a truncated pyramid.

15

The covering layers may consist of metal, for example of Al or an Al alloy or of Cu or a Cu alloy, which is preferably from  $0.5 \text{ mm}$  to  $2.0 \text{ mm}$  thick.

20

However, the covering layers may also consist of plastic, e.g. of PET or PP or PS or ABS.

It is also possible to use a Resopal plate as the covering layer. A Resopal plate of this type is from  $0.4 \text{ mm}$  to  $2.0 \text{ mm}$ , preferably  $1.3 \text{ mm}$ , thick.

25

The covering layers are preferably adhesively bonded to the flexible metal foil.

30

The covering layers may not only be planar but may also be curved, since the intermediate layer can adapt to its shape. Moreover, it may be structured, for example it may have ribs.

35

Finally, it is also possible for a sandwich panel to be formed in multilayer form. For this purpose, a further intermediate layer comprising flexible metal foil with cup-like recesses is applied to one of the covering

layers, and a further covering layer is secured to the intermediate layer.

5 A method for producing a body component which achieves the object of the invention forms the subject matter of patent claim 11. By contrast to the method according to patent claim 1, in this method the other covering layer is formed directly by the metal body sheet.

10 The laminated structure which is bonded on ensures that the body component has a high strength combined with a low weight. In particular the torsional rigidity is very high. Moreover, the body component according to the invention has good acoustic properties and  
15 excellent resistance to corrosion.

The adhesive used is preferably an encapsulated, heat-activatable adhesive system which is activated at a temperature of over 165°C and then fully reacts. The  
20 laminated structure and the metal body sheet are joined by the application of pressure and the simultaneous supply of heat. The body component is then able to withstand temperatures of over 200°C.

25 Before the joining operation, encapsulated foam systems or foam systems provided with microcapsules may be introduced between laminated structure and metal body sheet, which foam systems are activated during the joining. This results in good heat and sound  
30 insulation.

The covering layer is preferably an aluminum sheet.

35 The method according to the invention can be used to produce, for example, car roofs, hoods, trunk lids, doors or other three-dimensionally deformed components as the body components.

Exemplary embodiments of the invention are explained in more detail below with reference to drawings, in which:

- 5    Fig. 1    shows a plan view of an intermediate layer of a first embodiment of a sandwich panel,
- Fig. 2    shows a first variant of a cup-like recess,
- Fig. 3    shows a second variant of a cup-like recess,
- Fig. 4    diagrammatically depicts the procedure involved
- 10          in a method for producing a sandwich panel,
- Fig. 5    shows an exploded view of a second embodiment of the sandwich panel, as seen from the side,
- Fig. 6    shows an exploded view of the sandwich panel shown in Fig. 5, as seen from above,
- 15    Fig. 7    shows a double-layer intermediate layer,
- Fig. 8    shows a side view of a third embodiment of a sandwich panel with a double-layer intermediate layer,
- Fig. 9    shows a side view of a fourth embodiment of a sandwich panel with a double-layer intermediate layer,
- 20          Fig. 10 shows a laminated structure for producing a car roof,
- Fig. 11 shows a partial cross section through a car roof,
- 25          Fig. 12 shows the detail XII from Fig. 11.

30    The intermediate layer 1 shown in Fig. 1 comprises a flexible metal foil, into which a multiplicity of recesses 2 have been stamped with a uniform distribution in one direction. This can be achieved, for example, by pressing or by deep-drawing.

35    The flexible metal foil of the intermediate layer 1 may consist, for example, of Al, an Al alloy or of Cu or a Cu alloy, or other metals which can be drawn or stamped. It is customary to employ metal foils which

are from 10  $\mu\text{m}$  to 200  $\mu\text{m}$  thick. In most application examples, however, the flexible metal foil is from 20  $\mu\text{m}$  to 100  $\mu\text{m}$  thick.

- 5 The material used for the flexible metal foil of the intermediate layer 1 preferably has a modulus of elasticity of at least two  $2 \times 10^3 \text{ N/mm}^2$  in the case of plastics and  $70 \times 10^3 \text{ N/mm}^2$  in the case of metals (e.g. aluminum).

10

The cup-like recesses 2 may be in various forms. Two particularly expedient shapes for the cup-like recesses 2 are shown in Figures 2 and 3.

- 15 The recess 2 shown in Fig. 2 is in the shape of half an ellipsoid, while the recess 2 shown in Fig. 3 is in the shape of half an ellipsoid which has been cut off in a straight line at its free end 8.

- 20 The cup-like recesses 2 may also be formed in the shape of spheres, cylinders, truncated cones or truncated pyramids. The diameter of the cup-like recesses preferably approximately corresponds to the thickness of the flexible metal foil which has been deformed into  
25 the intermediate layer.

- After the cup-like recesses 2 have been formed in the flexible metal foil in order to form the intermediate layer 1, a covering layer 3 or 4 is applied to both  
30 sides of the intermediate layer 1. In the process, at each recess 2, firstly the opening 7 of the recess 2 is closed by one covering layer 3, and only then is the other covering layer 4 joined to the free end 8 of the corresponding recess 2.

35

This is important since closing the opening 7 of the recess 2 by means of the covering layer 3 leads to an

air cushion being formed in the recess 2, which prevents the recess 2, which consists of flexible material, being compressed when the other covering layer 4 is applied.

5

The latter method steps are diagrammatically illustrated in Fig. 4. The arrows in Fig. 4 indicate the direction of movement of the individual components. The intermediate layer 1 is conveyed continuously in one plane. A covering layer 3, which is coated with an adhesive 9, for example a polyurethane adhesive, on the side which faces the intermediate layer 1 is fed continuously to that side of the intermediate layer 1 which is provided with the openings 7 of the recesses 2 and is adhesively bonded thereto, with the result that the openings 7 are closed off by the covering layer 3. The covering layer 4, which is likewise coated with an adhesive 9, for example a polyurethane adhesive, on the side which faces the intermediate layer 1 is fed to the intermediate layer 1 - after the covering layer 3, as seen in the direction of movement of the intermediate layer 1 - and is adhesively bonded to the free ends 8 of the recesses 2. At this time, the openings 7 of the recesses 2 have already been closed off by the covering layer 3. Then, the sandwich structure formed in this way is cut into sandwich panels of the desired size.

It is also possible first of all to apply only the covering layer 3 to the intermediate layer 1 on the side of the openings 7, and for this component to be temporarily stored as a laminated structure, which is described in more detail below with reference to Fig. 10. The other covering layer 4 can be applied at a later time. This allows the optional application of a very wide range of covering layers 4.

The covering layers 3, 4 may consist of metal, e.g. of Al or an Al alloy or of Cu or a Cu alloy. Depending on the particular application, the thickness of the covering layers 3, 4 is normally from 0.5 mm to 2.0 mm.  
5 However, it is also possible to use thicker or thinner covering layers 3, 4.

The covering layers 3, 4 may also consist of plastics, for example of PET or PP or PS or ABS or may be  
10 designed as Resopal plates. In this case, it is preferable to use Resopal plates with a thickness of from 0.4 mm to 2.0 mm.

In the second embodiment of the sandwich panel, which  
15 is shown in Fig. 5 and 6, the covering layers 3, 4 are not coated with an adhesive. A double-sided adhesive sheet 5 is in each case arranged between the covering layers 3, 4 and the intermediate layer 1. The adhesive sheet 5 is activated by thermal means.

20 It is also possible for an encapsulated adhesive system to be used as the adhesive. An encapsulated adhesive system is a two-stage adhesive. A first component is activated at, for example, 70-80°C. The other component  
25 is activated during the deformation to form the component, at a temperature of, for example, 160-180°C. This results in a transition from thermoplastic to thermoset.

30 Fig. 7 shows a two-layer intermediate layer 1 having a plurality of upwardly extending recesses 2' and a plurality of downwardly extending recesses 2, which are in each case formed in a flexible metal foil. A row of recesses 2 alternates with an adjoining row comprising  
35 recesses 2'. The two metal foils are adhesively bonded to one another, so that one metal foil forms the covering layer which closes off the recesses 2 or 2' of

the other metal foil. However, it is also possible for the recesses 2, 2' of each metal foil to be closed off by a covering layer and for these covering layers to be joined to one another.

5

The two-layer intermediate layer 1 shown in Fig. 7 is used in the second embodiment of the sandwich panel, which is shown in Fig. 8. In each case one double-sided adhesive sheet 5 or 5' is arranged between the free  
10 ends of the recesses 2, 2' and the associated covering layers 3 and 4. The recesses 2, 2' are in each case in the shape of half an elongate ellipsoid.

The fact that there are fewer upwardly extending  
15 recesses 2' than downwardly extending recesses 2 means that the bending resistance of the sandwich panel in one direction is greater than in the other direction, so that the sandwich panel can be bent in order to adapt its shape according to installation conditions.

20

The third embodiment shown in Fig. 9 differs from the second embodiment with regard to the shape of the recesses 2, 2' which in this case are formed in the shape of a compressed ellipsoid.

25

Fig. 10 shows a laminated structure 10 for the production of the car roof 22 which is shown in Fig. 11 and comprises an aluminum plate 10, an aluminum foil 16, which is provided with cup-like recesses 18, and a  
30 deformed metal body sheet 24, which are adhesively bonded to one another.

The laminated structure 10 comprises the aluminum plate 12, to the upper surface of which a double-sided  
35 adhesive sheet 14 has been stuck. The aluminum foil 16, into which a multiplicity of cup-like cylindrical recesses 18 has been stamped in one direction, is



adhesively bonded to the opposite side of the adhesive sheet 14 from the aluminum plate 12. The adhesive sheet 14 is activated by thermal means. The adhesive sheet 14 causes the openings 28 of the recesses 18 in the aluminum foil 16 to be closed off in an airtight manner. The end faces 26 of the recesses 18 are planar and run parallel, at one height, to the aluminum plate 12.

10 An encapsulated adhesive system 20, the first component of which has been activated at 70-80°C, is applied to the end faces 26 of each of the recesses 18. The other component has an activation temperature of 160-180°C.

15 The laminated structure 10 can be temporarily stored in this state.

To produce the car roof 22 shown in Fig. 11, the laminated structure 10 is laid, in a press tool, onto the inner side of a metal body sheet 24 which has already been deformed, in such a way that the end faces 26 bear against the metal body sheet 24, the encapsulated adhesive system 20 being arranged between the metal body sheet 24 and the end faces 26.

25 Then, the laminated structure 10 and the metal body sheet 24 are joined under pressure, with heat being supplied at the same time, the temperature of this heat being above the activation temperature of the second component of the encapsulated adhesive system 20. This results in a transition of the adhesive system 20 from the thermoplastic to the thermoset, with the result that a thermally stable bond is formed.

35 The metal body sheets 24 used are preferably steel sheets or aluminum sheets with a thickness of less than 0.6 mm. The thickness of the aluminum plate 12 is

preferably from 100 to 200  $\mu$ . The recesses 18 preferably have an external diameter of from 5 to 8 mm, a height of from 2 to 5 mm and are distributed uniformly at intervals of from 2 to 5 mm. As an alternative to the adhesive sheet 14, it is also possible to use a different thermoplastic or encapsulated adhesive.

Before the joining operation, encapsulated foam systems  
10 or foam systems provided with microcapsules may be  
introduced between laminated structure and metal body  
sheet, and these foam systems are activated during the  
joining. This results in good heat and sound  
insulation.

**Patent claims**

1. A method for producing a sandwich panel,  
5 comprising the following steps:
- forming a multiplicity of cup-like recesses in a flexible metal foil, and
  - applying a covering layer to each side of the flexible metal foil, during which process, at  
10 each cup-like recess, first of all the opening is closed by one covering layer, and then the other covering layer is applied to the free ends of the recesses.
- 15 2. The method as claimed in claim 1, characterized in that the cup-like recesses are formed by pressing or by deep-drawing.
- 20 3. The method as claimed in one of the preceding claims, characterized in that the cup-like recesses are shaped substantially in the form of an ellipsoid or a sphere or a cylinder or a truncated cone or a truncated pyramid.
- 25 4. The method as claimed in one of the preceding claims, characterized in that at least one of the covering layers is adhesively bonded to the flexible metal foil.
- 30 5. A sandwich panel having two covering layers (3, 4), which run substantially parallel to one another, and an intermediate layer (1), which extends between the two covering layers (3, 4), characterized in that the intermediate layer (1) has a flexible metal  
35 foil which is provided with a multiplicity of stamped-in cup-like recesses (2), the openings (7) of which are closed.

6. The sandwich panel as claimed in claim 5, characterized in that the covering layers (3, 4) are substantially planar.

5

7. The sandwich panel as claimed in claim 5, characterized in that the covering layers (3, 4) are curved and/or structured.

10 8. The sandwich panel as claimed in one of claims 5 to 7, characterized by at least one further flexible aluminum foil having a multiplicity of stamped-in cup-like recesses (2').

15 9. The sandwich panel as claimed in claim 8, characterized in that the recesses (2) in one metal foil and the recesses (2') in the further aluminum foil extend in opposite directions.

20 10. The sandwich panel as claimed in one of claims 8 or 9, characterized in that a different number of recesses (2, 2') is formed in the two flexible metal foils.

25 11. A method for producing a body component, comprising the following steps:

- forming a multiplicity of cup-like recesses, which point in one direction, in a flexible metal foil,
- 30 - forming a laminated structure by applying a covering layer to that side of the flexible metal foil on which the openings of the cup-like recess are located,
- applying an adhesive to the end faces of the
- 35 recesses,
- joining the laminated structure to a metal body sheet, the end faces of the laminated structure

being adhesively bonded to the metal body sheet  
by means of the adhesive.

12. The method as claimed in claim 11, characterized  
5 in that the laminated structure and the metal body  
sheet are joined by the application of pressure and the  
simultaneous supply of heat.

13. The method as claimed in claim 11 or 12,  
10 characterized in that the adhesive is an encapsulated,  
heat-activatable adhesive system.

14. The method as claimed in one of claims 11 to 13,  
characterized in that, before the joining operation,  
15 foam systems, which are activated during the joining,  
are introduced between the laminated structure and the  
metal body sheet.

15. The method as claimed in one of claims 11 to 14,  
20 characterized in that the covering layer is an aluminum  
sheet.

16. A body component, having  
- a flexible metal foil (16), in which a  
25 multiplicity of cup-like recesses (18), which  
point in one direction, are formed,  
- a covering layer (12) which is applied to that  
side of the flexible metal foil (16) on which  
the openings (28) of the cup-like recesses (18)  
30 are located,  
- a metal body sheet (24), which is joined to the  
end faces (26) of the recesses (18) by means of  
an adhesive.

35 17. The body component as claimed in claim 16,  
characterized in that the metal foil (16) and the  
covering layer (12) consist of aluminum.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES  
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum  
Internationales Büro



(43) Internationales Veröffentlichungsdatum  
15. März 2001 (15.03.2001)

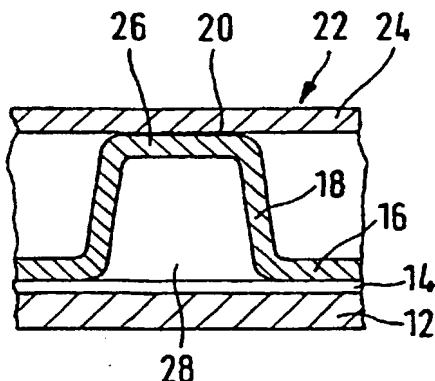
PCT

(10) Internationale Veröffentlichungsnummer  
WO 01/17764 A1

- (51) Internationale Patentklassifikation<sup>7</sup>: B32B 3/28, E04C 2/32, B62D 25/00, B21D 47/00
- (21) Internationales Aktenzeichen: PCT/EP00/08562
- (22) Internationales Anmeldedatum:  
1. September 2000 (01.09.2000)
- (25) Einreichungssprache: Deutsch
- (26) Veröffentlichungssprache: Deutsch
- (30) Angaben zur Priorität:  
199 42 922.7 8. September 1999 (08.09.1999) DE
- (71) Anmelder (für alle Bestimmungsstaaten mit Ausnahme von US): ALUSUISSE KAPA GMBH [DE/DE]; Kiefernweg 10, 49090 Osnabrück (DE).
- (72) Erfinder; und
- (75) Erfinder/Anmelder (nur für US): BEHRE, Kurt [DE/DE]; Im Grünen Tal 24, 49078 Osnabrück (DE).
- (74) Anwälte: HANO, Christian usw.; Mariahilfplatz 2 & 3, 81541 München (DE).
- (81) Bestimmungsstaaten (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Bestimmungsstaaten (regional): ARIPO-Patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI-Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Veröffentlicht:  
— Mit internationalem Recherchenbericht.  
— Vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eintreffen.
- Zur Erklärung der Zweibuchstaben-Codes, und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(54) Title: METHOD FOR PRODUCING A SANDWICH PANEL AND A BODY COMPONENT

(54) Bezeichnung: VERFAHREN ZUR HERSTELLUNG EINES SANDWICH-PANEELS SOWIE ZUR HERSTELLUNG EINES KAROSSERIEBAUTEILS



(57) Abstract: The invention relates to methods for producing a light component (a sandwich panel or a component for a vehicle body) that is easy to construct. A plurality of cup-like cavities (18) are embodied in a flexible metal foil (16). An outer layer (12, 24) is applied to each side of the flexible metal foil (16). The opening of each cup-like cavity (18) is first covered by an outer layer (12) and the remaining outer layer (24) is then applied to the free ends of the cavities (18). An already formed sheet metal (24) of the body can be connected to the tip surfaces (26) of the cup-like cavities (18) by means of an adhesive (26) for producing a car body component (22), whereby said sheet metal is used as the remaining outer layer.

(57) Zusammenfassung: Bei den Verfahren werden zur Herstellung eines konstruktiv einfachen und leichten Bauelements (Sandwich-paneel oder Autokarosseriebauteil) eine Vielzahl von napfartigen Vertiefungen (18) in einer flexiblen Metallfolie (16) ausgebildet. Dann wird eine Deckschicht (12, 24) auf jede Seite der flexiblen Metallfolie (16) aufgebracht, wobei bei jeder napfartigen Vertiefung (18) zunächst die Öffnung durch eine Deckschicht (12) verschlossen und dann die andere Deckschicht (24) an den freien Enden der Vertiefungen (18) angebracht wird. Zur Herstellung eines Autokarosseriebauteils (22) kann als andere Deckschicht ein bereits verformtes Karosserieblech (24) mit den Kopfflächen (26) der napfartigen Vertiefungen (18) mittels eines Klebemittels (26) verbunden werden.

(12, 24) auf jede Seite der flexiblen Metallfolie (16) aufgebracht, wobei bei jeder napfartigen Vertiefung (18) zunächst die Öffnung durch eine Deckschicht (12) verschlossen und dann die andere Deckschicht (24) an den freien Enden der Vertiefungen (18) angebracht wird. Zur Herstellung eines Autokarosseriebauteils (22) kann als andere Deckschicht ein bereits verformtes Karosserieblech (24) mit den Kopfflächen (26) der napfartigen Vertiefungen (18) mittels eines Klebemittels (26) verbunden werden.

Rec'd 06 MAR 2002

WO 01/17764 A1

1/5

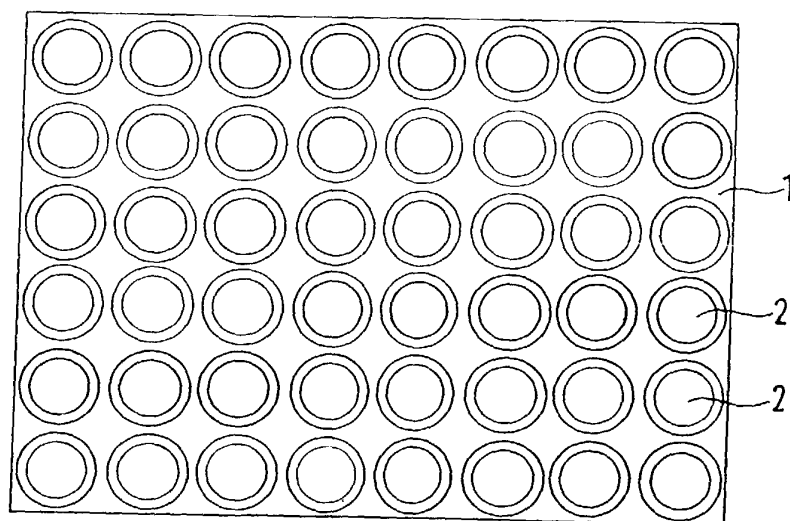


FIG. 1

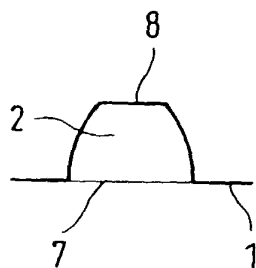


FIG. 3

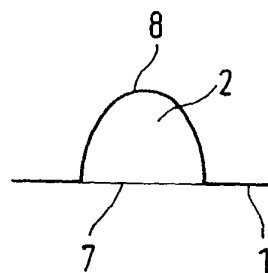
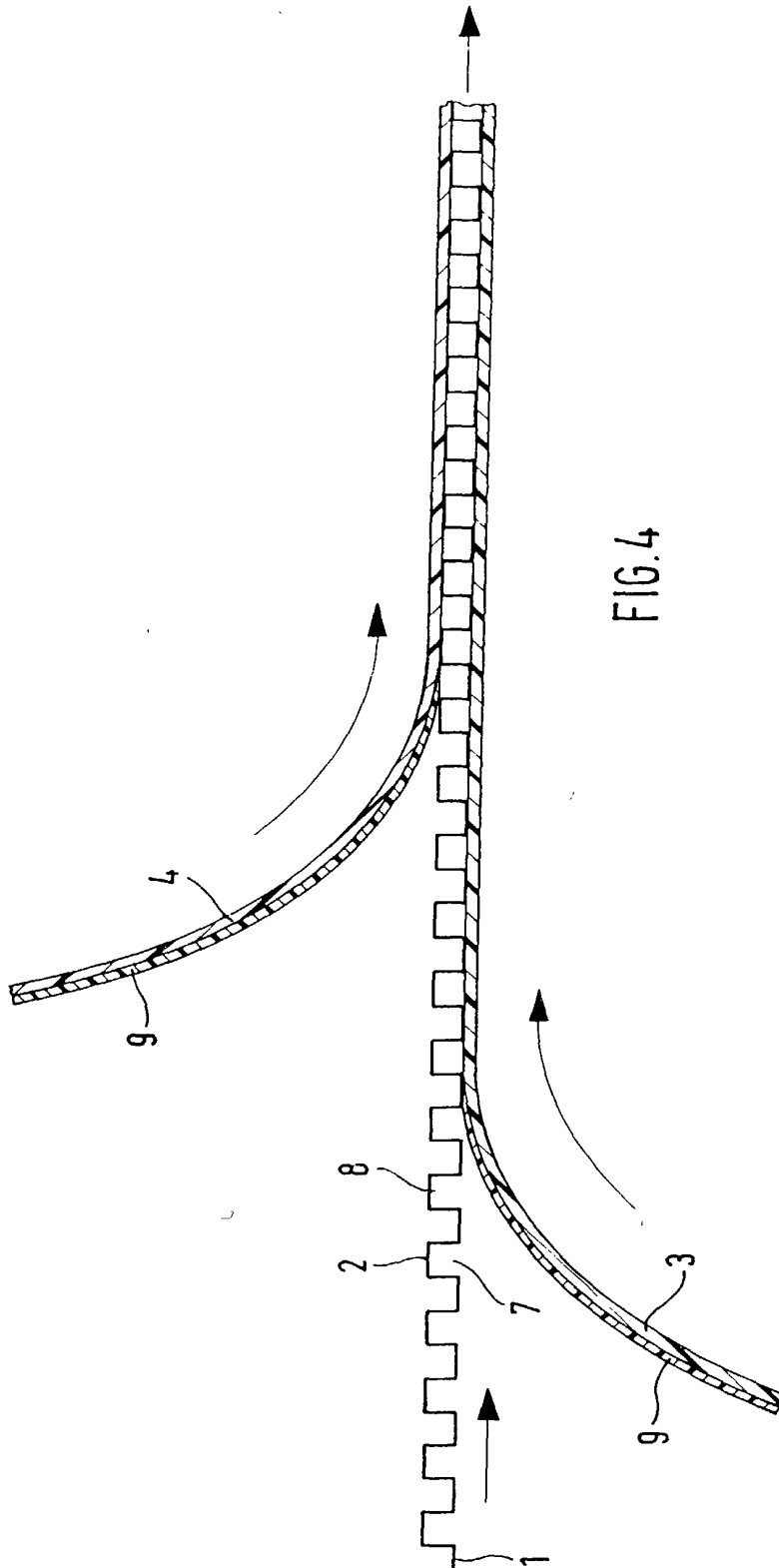


FIG. 2

2/5





3/5

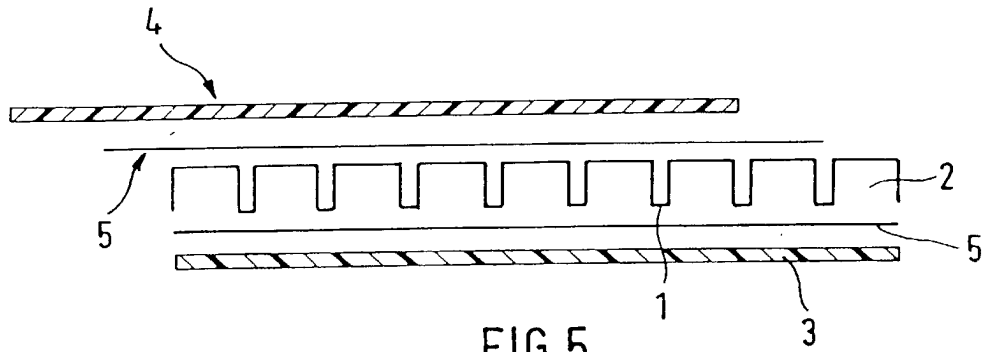


FIG. 5

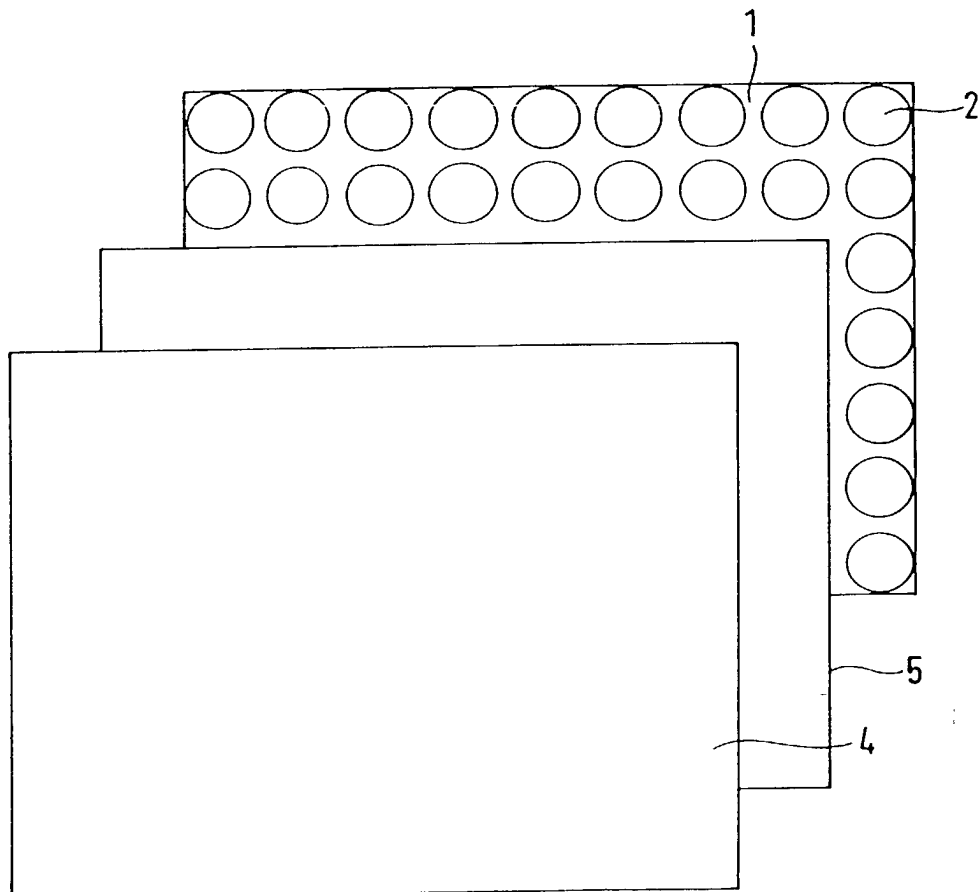


FIG. 6

4/5

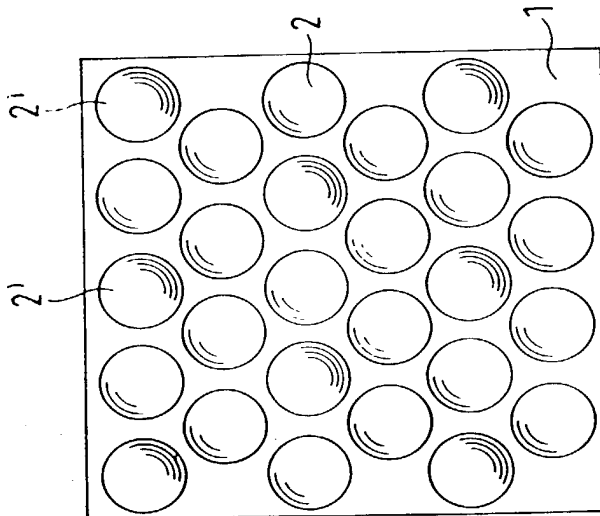


FIG. 7

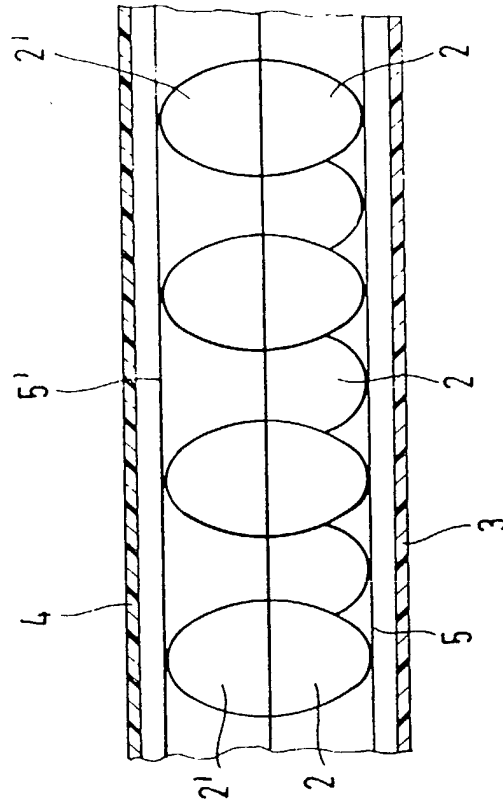


FIG. 8

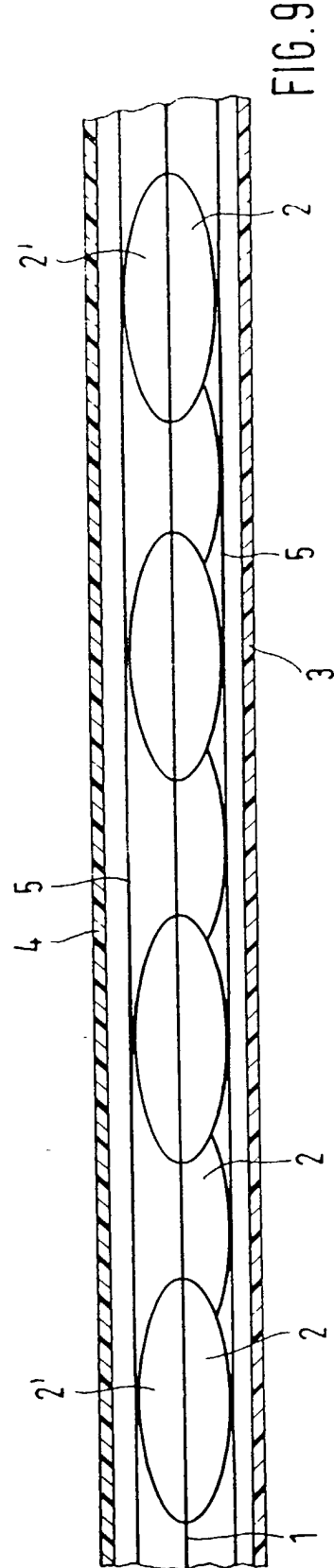
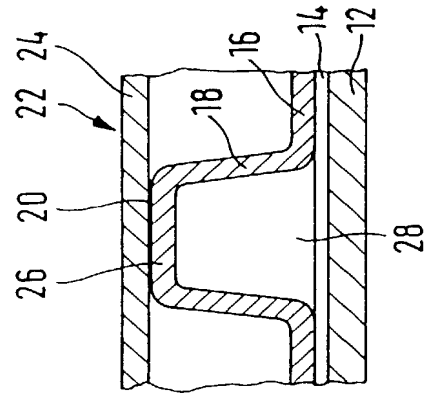
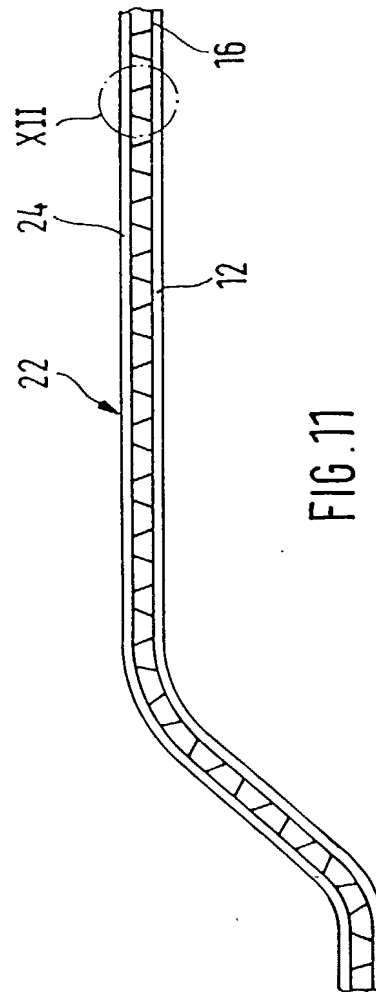
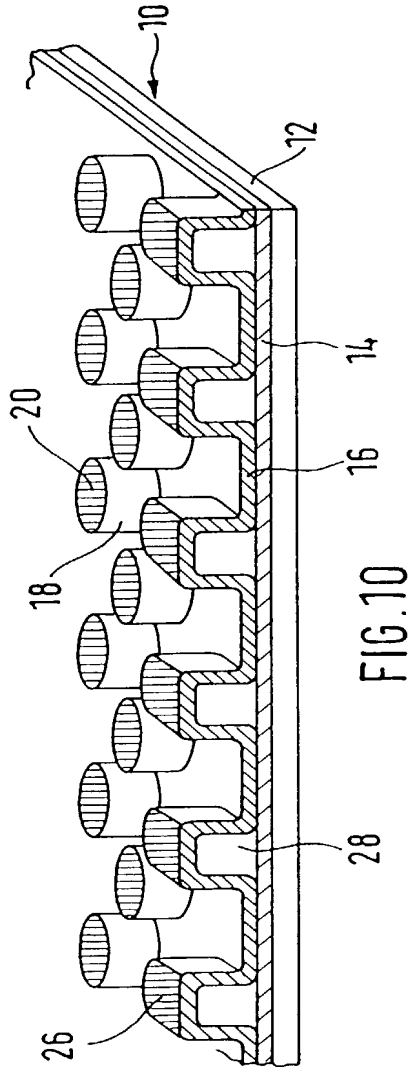


FIG. 9



**DECLARATION AND POWER OF  
ATTORNEY FOR UTILITY OR DESIGN  
PATENT APPLICATION  
(37 CFR 1.63)**

☐ Declaration  
Submitted  
with Initial  
Filing

☒ Declaration  
Submitted  
after Initial  
Filing

**COMPLETE IF KNOWN**

Application Number 10/070,378

Filing Date

Group Art Unit

Examiner Name

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **METHOD FOR PRODUCING A SANDWICH PANEL AND A BODY COMPONENT**, the specification of which was filed on September 1, 2000 as PCT International Application Number PCT/EP00/08562 and was amended on March 6, 2002.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including to continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Numbers	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
19942922.7	DE	09/08/1999	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

I or we hereby appoint the registered practitioner(s) associated with Customer No. **6449** to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. Direct all correspondence to Customer Number **6449**.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

<b>NAME OF SOLE OR FIRST INVENTOR:</b>		<input type="checkbox"/> A petition has been filed for this unsigned inventor	
Given Name (first and middle [if any]) Kurt		Family Name or Surname BEHRE	
Inventor's Signature <i>Kurt Behre</i>		Date 06/24/2002	
Residence: City Osnabrueck		State	Country Germany DEX
Mailing Address Im Gruenen Tal 24, D-49078 Osnabrueck, Germany		Citizenship Germany	
<b>NAME OF SECOND INVENTOR:</b>		<input type="checkbox"/> A petition has been filed for this unsigned inventor	
Given Name (first and middle [if any])		Family Name or Surname	
Inventor's Signature		Date	
Residence: City		State	Country
Mailing Address		Citizenship	
<b>NAME OF THIRD INVENTOR:</b>		<input type="checkbox"/> A petition has been filed for this unsigned inventor	
Given Name (first and middle [if any])		Family Name or Surname	
Inventor's Signature		Date	
Residence: City		State	Country
Mailing Address		Citizenship	
<b>NAME OF FOURTH INVENTOR:</b>		<input type="checkbox"/> A petition has been filed for this unsigned inventor	
Given Name (first and middle [if any])		Family Name or Surname	
Inventor's Signature		Date	
Residence: City		State	Country
Mailing Address		Citizenship	
City		State	Zip
<b>NAME OF FIFTH INVENTOR:</b>		<input type="checkbox"/> A petition has been filed for this unsigned inventor	
Given Name (first and middle [if any])		Family Name or Surname	
Inventor's Signature		Date	
Residence: City		State	Country
Mailing Address		Citizenship	
City		State	Zip